

### Modeling Linear Systems.

#### Number Problems

The sum of Xavier and Yana age is 36, Xavier is 4 years older than Yana. What are their ages?

Solution:

Let  $x$  be Xavier's age.

Let  $y$  be Yana's age

$$x + y = 36$$

$$x - y = 4$$

These problems are more straightforward, just let  $x$  and  $y$  represent the two quantities you are looking for and have linear equations to model their relationships.

Break-even Questions

ABC's rent-a-car charges \$50 per day, plus 12 cents a km.

XYZ's rent a car charges \$40 per day plus 20 cents a km. At what distance do they drive the same?

Let  $C$  be the total cost of the car.

Let  $d$  be the distance driven

$$C = 0.12d + 50$$

$$C = 0.20d + 40$$

Here we know  $C$  is the same for each company, and we need to solve for  $d$ .

|     | Flat fee | km Charge | Total        |
|-----|----------|-----------|--------------|
| ABC | 50       | $0.12d$   | $50 + 0.12d$ |
| XYZ | 40       | $0.20d$   | $40 + 0.20d$ |

Mixture problems.

These problems can involve interest rates, selling different types of food and mixing chemical solutions, for example. Here making a table is very useful.

Two types of coffee beans are blended, they cost \$2.30 /kg and \$3.20 a kg. How much of each kind was used if 200kg of the resulting mixture cost \$3/kg.

Let  $x$  be amount of the \$2.30 beans,

Let  $y$  be the amount of the \$3.20 beans.

|        | Cost | Amount |                          |
|--------|------|--------|--------------------------|
| Type 1 | 2.30 | $x$    | $2.30x$                  |
| Type 2 | 3.20 | $y$    | $3.20y$                  |
| Total  |      | 200    | $200 \times \$3 = \$600$ |

The trick is to think about the total here it isn't \$3

$$\text{So } x + y = 200$$

$$2.3x + 3.2y = 600$$

Distance Time Problems

Garry drove to Sarnia, part of the time on country roads, and part on major highways. He average 100km/hr on highways and 80km/hr on country rods. Overall he spend 12 hours driving 1050km. How long did he drive on each road.

|         | Speed     | Time | Distance |
|---------|-----------|------|----------|
| Country | 80 km/hr  | x    | 80x      |
| Highway | 100 km/hr | y    | 100y     |
| Total   |           | 12   | 1050     |

$$x + y = 12$$

$$80x + 100y = 1050$$

Alternatively, if you let x be the distance on country roads and y the distance on highways. You would get

$$x + y = 1050$$

$$x/80 + x/50 = 12$$

To check your answer for reasonableness, note that an average speed of 90km/hr would give you 1080km, so just a bit more time is spent on country roads.

#### Level 4 Motion problems

1. On a canoe trip, Rita paddled upstream (against the current) at an average speed of 2mi/h relative to the riverbank. On the return trip downstream (with the current), her average speed was 3 mi/h. Find Rita's paddling speed in still water and the speed of the river's current.

2. Jill has a jet ski that will travel at 35km/hr in still water. She can go 50 km up the river in the same amount of time she can go 75 down the river.

1. How fast can Jill travel going down the river?
2. What is the total time for the trip?